Claims

What is claimed is:

1. A frit comprising:

a porous support structure having a plurality of void spaces; and

a plurality of secondary particles, wherein the void spaces are filled with the plurality of secondary particles such that the frit has a density of at least 50%, and wherein the secondary particles are dimensioned with respect to the void spaces for the frit to retain packing materials with diameters of less than about 2.5 microns.

2. The frit of claim 1, wherein the void spaces are partially filled with the secondary particles.

3. The frit of claim 1, wherein the void spaces are completely filled with the secondary particles.

4. The frit of claim 1, wherein the secondary particles form within the void spaces a secondary pore network having a pore size that is capable of retaining chromatographic packing materials with diameters of less than about 2.5 microns.

5. The frit of claim 1, wherein the frit is sintered after the void spaces are filled with the plurality of secondary particles.

6. The frit of claim 1, wherein the porous support structure is heated to immobilize the secondary particles that fill the void spaces.

7. The frit of claim 6, wherein the secondary particles are sintered to each other, to the porous support structure surrounding the void spaces, or both.

8. The frit of claim 1, wherein the porous support structure comprises a material selected from the group consisting of metals, metal alloys, metal oxides, ceramics, and polymers.

9. The frit of claim 1, wherein the porous support structure comprises a material selected from the group consisting of sinterable metals, sinterable metal alloys, sinterable metal oxides, sinterable ceramics, and sinterable polymers.

10. The frit of claim 1, wherein the porous support structure comprises a material selected from the group consisting of stainless steel, titanium, PEEK, polyethylene, Hastaloy™, polypropylene, Teflon™, glass, silica, titania, and zirconia.

11. The frit of claim 1, wherein the porous support structure comprises stainless steel.

12. The frit of claim 1, wherein the porous support structure comprises 316 stainless steel.

13. The frit of claim 1, wherein the porous support structure has a media grade ranging from about 0.5 to about 10.

14. The frit of claim 1, wherein the porous support structure is 0.5 media grade sintered stainless steel.

15. The frit of claim 1, wherein the porous support structure is 2.0 media grade sintered stainless steel.

16. The frit of claim 1, wherein the secondary particles are about 5 microns in diameter or smaller.

17. The frit of claim 1, wherein the secondary particles range from about 3 microns to about 5 microns in diameter.

18. The frit of claim 1, wherein the secondary particles are about 3.5 microns in diameter.

19. The frit of claim 15, wherein the secondary particles are about 4 microns in diameter.

20. The frit of claim 1, wherein the porous support structure is 0.5 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

21. The frit of claim 1, wherein the porous support structure is 2.0 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

22. The frit of claim 1, wherein the secondary particles have the same composition as the packing materials retained by the frit.

23. The frit of claim 1, wherein the secondary particles have a different composition than the packing materials retained by the frit.

24. The frit of claim 1, wherein the secondary particles have the same composition as the porous support structure.

25. The frit of claim 1, wherein the secondary particles have a different composition than the porous support structure.

26. The frit of claim 1, wherein the secondary particles are spherical stainless steel particles.

27. The frit of claim 1, wherein the packing materials retained by the frit are chromatographic packing materials.

28. The frit of claim 27, wherein the chromatographic packing materials are selected from the group consisting of silica gel, derivatized silica gel, zirconia, derivatized zirconia, titanium oxide, derivatized titanium oxide, organo-silica hybrids, derivatized organo-silica hybrids, hybrids of metal oxides, and derivatized hybrids of metal oxides.

29. The frit of claim 1 for use in a chromatography column.

30. The frit of claim 29, wherein the chromatography column is a high pressure liquid chromatography (HPLC) column.

31. The frit of claim 29, wherein the chromatography column is a high pressure liquid chromatography column packed with chromatographic packing materials with particle diameters of less than about 2.5 microns.

32. The frit of claim 1, wherein the secondary particles fill the void spaces of the porous support structure to a depth of greater than about 10 microns.

33. The frit of claim 1, wherein the frit is oriented with respect to a flow direction through a tubular chamber.

34. The frit of claim 1, further including a tubular chamber for receiving the frit, the frit being oriented with respect to a flow direction through the tubular chamber.

35. The frit of claim 1, wherein the frit is configured as an in-line filter for use in a chromatography system.

36. The frit of claim 35, wherein the frit is arranged upstream of a column in the chromatography system.

37. The frit of claim 35, wherein the frit is arranged between a pump and an injector in the chromatography system.

38. The frit of claim 35, wherein the frit is arranged between an injector and a column in the chromatography system.

39. A frit configured to be received in a tubular chamber, the frit comprising:
a porous support structure having a plurality of void spaces; and a plurality of secondary particles, wherein the void spaces are filled with the plurality of secondary particles so as to retain chromatographic packing materials, the secondary particles being dimensioned with respect to the void spaces and the packing materials such that the frit retains the packing materials with diameters of less than about 2.5 microns, wherein the frit is oriented with respect to a flow direction through the tubular chamber.

40. A frit comprising:

a porous support structure having a plurality of void spaces; and a plurality of secondary particles, wherein the void spaces are filled with the plurality of secondary particles to a depth of greater than about 10 microns, and wherein the secondary particles are dimensioned with respect to the void spaces such that the frit retains packing materials with diameters of less than about 2.5 microns.

41. The frit of claim 40, wherein the depth ranges from about 28 microns to about 178 microns.

42. A chromatography column, comprising:

a tubular chamber having first and second ends, the tubular chamber being filled with a chromatographic packing material; and at least one frit received in the first or second ends, the frit having:

a porous support structure having a plurality of void spaces, and a plurality of secondary particles, wherein the void spaces are filled with the plurality of secondary particles, and wherein the secondary particles are dimensioned with respect to the void spaces such that the frit retains the chromatographic packing material with particle diameters of less than about 2.5 microns.

43. The chromatography column of claim 42, further comprising a fitting connected to at least one end of the chamber, the at least one frit being press fit into the fitting.

44. The chromatography column of claim 42, wherein the column is a high pressure liquid chromatography (HPLC) column.

45. The chromatography column of claim 44, further comprising inlet and outlet fittings operably connected to the first and second ends of the tubular chamber.

46. The chromatography column of claim 45, wherein the at least one frit is press fit into the inlet fitting or the outlet fitting.

47. The chromatography column of claim 45, wherein the at least one frit is arranged in an opening of the inlet fitting or an opening of the outlet fitting.

48. The chromatography column of claim 45, wherein a first frit is press fit into the inlet fitting, and a second frit is press fit into the outlet fitting.

49. The chromatography column of claim 48, wherein each of the frits is received in a circular planar ring, and each corresponding ring and frit are configured to seal the inlet fitting and the outlet fitting, respectively, with the tubular chamber.

50. The chromatography column of claim 45, wherein a first frit is arranged in an opening of the inlet fitting, and a second frit is arranged in an opening of the outlet fitting.

51. The chromatography column of claim 45, wherein the first and second frits are arranged in the tubular chamber.

52. The chromatography column of claim 45, wherein the first and second frits are press fit into ends of the tubular chamber.

53. The chromatography column of claim 44, wherein the at least one frit is press fit into a sealing ring.

54. The chromatography column of claim 44, wherein the column can withstand pressures of about 5,000 to 50,000 psi.

55. The chromatography column of claim 44, wherein the inlet and outlet fittings are threaded to the first and second ends of the tubular chamber, respectively.

56. The chromatography column of claim 42, wherein the frit is oriented with respect to a flow direction through the tubular chamber.

57. The chromatography column of claim 42, wherein the void spaces are filled with the plurality of secondary particles such that the frit has a density of at least 50%.

58. The chromatography column of claim 42, wherein the void spaces are partially filled with the secondary particles.

59. The chromatography column of claim 42, wherein the void spaces are completely filled with the secondary particles.

60. The chromatography column of claim 42, wherein the secondary particles form within the void spaces a secondary pore network having a pore size that is capable of retaining the chromatographic packing material with particle diameters of less than about 2.5 microns.

61. The chromatography column of claim 42, wherein the frit is sintered after the void spaces are filled with the plurality of secondary particles.

62. The chromatography column of claim 42, wherein the porous support structure is heated to immobilize the secondary particles that fill the void spaces.

63. The chromatography column of claim 62, wherein the secondary particles are sintered to each other, to the porous support structure surrounding the void spaces, or both.

64. The chromatography column of claim 42, wherein the porous support structure comprises a material selected from the group consisting of metals, metal alloys, metal oxides, ceramics, and polymers.

65. The chromatography column of claim 42, wherein the porous support structure comprises a material selected from the group consisting of sinterable metals, sinterable metal alloys, sinterable metal oxides, sinterable ceramics, and sinterable polymers.

66. The chromatography column of claim 42, wherein the porous support structure comprises a material selected from the group consisting of stainless steel, titanium, PEEK, polyethylene, Hastaloy™, polypropylene, Teflon™, glass, silica, titania, and zirconia.

67. The chromatography column of claim 42, wherein the porous support structure comprises stainless steel.

68. The chromatography column of claim 42, wherein the porous support structure comprises 316 stainless steel.

69. The chromatography column of claim 42, wherein the porous support structure has a media grade ranging from about 0.5 to about 10.

70. The chromatography column of claim 42, wherein the porous support structure is 0.5 media grade sintered stainless steel.

71. The chromatography column of claim 42, wherein the porous support structure is 2.0 media grade sintered stainless steel.

72. The chromatography column of claim 42, wherein the secondary particles are about 5 microns in diameter or smaller.

73. The chromatography column of claim 42, wherein the secondary particles range from about 3 to about 5 microns in diameter.

74. The chromatography column of claim 42, wherein the secondary particles are about 3.5 microns in diameter.

75. The chromatography column of claim 42, wherein the secondary particles are about 4 microns in diameter.

76. The chromatography column of claim 42, wherein the porous support structure is 0.5 media grade sintered stainless steel, and the secondary particles are about 3.5 microns in diameter.

77. The chromatography column of claim 42, wherein the porous support structure is 2.0 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

78. The chromatography column of claim 42, wherein the secondary particles have the same composition as the chromatographic packing material.

79. The chromatography column of claim 42, wherein the secondary particles have a different composition than the chromatographic packing material.

80. The chromatography column of claim 42, wherein the secondary particles have the same composition as the porous support structure.

81. The chromatography column of claim 42, wherein the secondary particles have a different composition than the porous support structure.

82. The chromatography column of claim 42, wherein the secondary particles are spherical stainless steel particles.

83. The chromatography column of claim 42, wherein the chromatographic packing material is selected from the group consisting of silica gel, derivatized silica gel, zirconia, derivatized zirconia, titanium oxide, derivatized titanium oxide, organo-silica hybrids, derivatized organo-silica hybrids, hybrids of metal oxides, and derivatized hybrids of metal oxides.

84. The chromatography column of claim 42, wherein the secondary particles fill the void spaces to a depth of greater than about 10 microns.

85. The chromatography column of claim 42, wherein the at least one frit is oriented with respect to a flow direction through the tubular chamber.

86. A chromatography column comprising:

a porous support structure having a plurality of void spaces;

a plurality of secondary particles, wherein the void spaces are filled with the plurality of secondary particles so as to retain chromatographic packing materials, the secondary particles being dimensioned with respect to the void spaces and the packing materials such that the frit retains the packing materials with diameters of less than about 2.5 microns; and a tubular chamber for receiving the frit, the frit being oriented with respect to a flow direction through the tubular chamber.

87. A method of preparing a frit for use in a high pressure liquid chromatography column, comprising the steps of:

providing a porous support structure having a plurality of void spaces; and filling the void spaces with secondary particles, wherein the secondary particles are dimensioned with

respect to the void spaces such that the frit retains chromatographic packing materials with particle diameters of less than about 2.5 microns.

88. The method of claim 87, wherein the void spaces are filled with the plurality of secondary particles such that the frit has a density of at least 50%.

89. The method of claim 87, further including a step of sintering the porous support structure and the secondary particles to immobilize the secondary particles in the void spaces.

90. The method of claim 89, wherein the secondary particles are sintered to each other, to the porous support structure surrounding the void spaces, or both.

91. The method of claim 87, further including a step of providing a tubular chamber having first and second ends, and inlet and outlet fittings operably connected to the first and second ends, respectively.

92. The method of claim 91, further including a step of press fitting the frit into one of the inlet and outlet fittings.

93. The method of claim 91, wherein inlet and outlet fittings are operably connected to the first and second ends of the tubular chamber, the at least one frit being received in the inlet fitting or the outlet fitting.

94. The method of claim 91, wherein a first frit is press fit into the inlet fitting, and a second frit is press fit into the outlet fitting.

95. The method of claim 91, wherein a first frit is arranged in an opening of the inlet fitting, and a second frit is arranged in an opening of the outlet fitting.

96. The method of claim 95, wherein each of the frits is received in a circular planar ring, and each corresponding ring and frit are configured to seal the inlet fitting and the outlet fitting, respectively, with the tubular chamber.

97. The method of claim 91, wherein a first frit and a second frit are arranged in the tubular chamber.

98. The method of claim 91, wherein a first frit and a second frit are press fit into ends of the tubular chamber.

99. The method of claim 87, wherein the porous support structure comprises a material selected from the group consisting of metals, metal alloys, metal oxides, ceramics, and polymers.

100. The method of claim 87, wherein the porous support structure comprises a material selected from the group consisting of sinterable metals, sinterable metal alloys, sinterable metal oxides, sinterable ceramics, and sinterable polymers.

101. The method of claim 87, wherein the porous support structure comprises a material selected from the group consisting of stainless steel, titanium, PEEK, polyethylene, Hastaloy™, polypropylene, Teflon™, glass, silica, titania, and zirconia.

102. The method of claim 87, wherein the porous support structure is a filter made of stainless steel.

103. The method of claim 87, wherein the porous support structure comprises 316 stainless steel.

104. The method of claim 87, wherein the porous support structure has a media grade of about 0.5 to 10.

105. The method of claim 87, wherein the porous support structure is 0.5 media grade sintered stainless steel.

106. The method of claim 87, wherein the porous support structure is 2.0 media grade sintered stainless steel.

107. The method of claim 87, wherein the secondary particles are about 3 to 5 microns in diameter.

108. The method of claim 87, wherein the secondary particles are about 3.5 microns in diameter.

109. The method of claim 87, wherein the secondary particles are about 4 microns in diameter.

110. The method of claim 87, wherein the porous support structure is 0.5 media grade sintered stainless steel, and the secondary particles are about 3.5 microns in diameter.

111. The method of claim 87, wherein the porous support structure is 2.0 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

112. The method of claim 87, wherein the secondary particles have the same composition as the chromatographic packing materials.

113. The method of claim 87, wherein the secondary particles have a different composition than the chromatographic packing materials.

114. The method of claim 87, wherein the secondary particles have the same composition as the porous support structure.

115. The method of claim 87, wherein the secondary particles have a different composition than the porous support structure.

116. The method of claim 87, wherein the secondary particles are spherical stainless steel particles.

117. The method of claim 87, wherein the secondary particles fill the void spaces of the porous support structure to a depth of greater than about 10 microns.

118. A method of preparing a frit for use in a high pressure liquid chromatography column, comprising the steps of:

providing a porous support structure having a plurality of void spaces; filling the void spaces with secondary particles; and orienting the porous support structure filled with the secondary particles such that the secondary particles remain immobilized in the void spaces during use, wherein the secondary particles are dimensioned with respect to the void spaces such that the frit retains chromatographic packing materials with particle diameters of less than about 2.5 microns.

119. The method of claim 118, the void spaces are filled with the plurality of secondary particles such that the frit has a density of at least 50%.

120. The method of claim 118, further including a step of providing a tubular chamber having first and second ends, and inlet and outlet fittings operably connected to the first and second ends, respectively.

121. The method of claim 120, further including a step of press fitting the frit into one of the inlet and outlet fittings.

122. The method of claim 120, wherein inlet and outlet fittings are operably connected to the first and second ends of the tubular chamber, the at least one frit being received in the inlet fitting or the outlet fitting.

123. The method of claim 122, wherein a first frit is press fit into the inlet fitting, and a second frit is press fit into the outlet fitting.

124. The method of claim 122, wherein a first frit is arranged in an opening of the inlet fitting, and a second frit is arranged in an opening of the outlet fitting.

125. The method of claim 122, wherein each of the frits is received in a circular planar ring, and each corresponding ring and frit are configured to seal the inlet fitting and the outlet fitting, respectively, with the tubular chamber.

126. The method of claim 122, wherein a first frit and a second frit are arranged in the tubular chamber.

127. The method of claim 122, wherein a first frit and a second frit are press fit into ends of the tubular chamber.

128. The method of claim 118, wherein the porous support structure comprises a material selected from the group consisting of metals, metal alloys, metal oxides, ceramics, and polymers.

129. The method of claim 118, wherein the porous support structure comprises a material selected from the group consisting of sinterable metals, sinterable metal alloys, sinterable metal oxides, sinterable ceramics, and sinterable polymers.

130. The method of claim 118, wherein the porous support structure comprises a material selected from the group consisting of stainless steel, titanium, PEEK, polyethylene, Hastaloy™, polypropylene, Teflon™, glass, silica, titania, and zirconia.

131. The method of claim 118, wherein the porous support structure is a filter made of stainless steel.

132. The method of claim 118, wherein the porous support structure comprises 316 stainless steel.

133. The method of claim 118, wherein the porous support structure has a media grade of about 0.5 to 10.

134. The method of claim 118, wherein the porous support structure is 0.5 media grade sintered stainless steel.

135. The method of claim 118, wherein the porous support structure is 2.0 media grade sintered stainless steel.

136. The method of claim 118, wherein the secondary particles are about 3 to 5 microns in diameter.

137. The method of claim 118, wherein the secondary particles are about 3.5 microns in diameter.

138. The method of claim 118, wherein the secondary particles are about 4 microns in diameter.

139. The method of claim 118, wherein the porous support structure is 0.5 media grade sintered stainless steel, and the secondary particles are about 3.5 microns in diameter.

140. The method of claim 118, wherein the porous support structure is 2.0 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

141. The method of claim 118, wherein the secondary particles have the same composition as the chromatographic packing materials.

142. The method of claim 118, wherein the secondary particles have a different composition than the chromatographic packing materials.

143. The method of claim 118, wherein the secondary particles have the same composition as the porous support structure.

144. The method of claim 118, wherein the secondary particles have a different composition than the porous support structure.

145. The method of claim 118, wherein the secondary particles are spherical stainless steel particles.

146. The method of claim 118, wherein the orienting step includes arranging the frit a direction of flow through the high pressure liquid chromatography column.

147. The method of claim 118, wherein the secondary particles fill the void spaces of the porous support structure to a depth of greater than about 10 microns.

148. A chromatographic system for separating and quantifying solutes in a liquid stream, comprising: a tubular chamber having first and second ends, the tubular chamber being filled with chromatographic packing materials; at least one frit received in the first and second ends of the tubular chamber, the frit having a porous support structure having a plurality of void spaces, and a plurality of secondary particles, wherein the void spaces are filled with the plurality of secondary particles, and wherein the secondary particles are dimensioned with respect to the void spaces such that the frit retains chromatographic packing materials with particle diameters of less than about 2.5 microns; a pump for propelling the liquid stream through the tubular chamber, the liquid stream contacting the chromatographic packing materials in the tubular chamber;

an injector for delivery of a sample into the liquid stream; and

a detector for detecting individual components of the liquid stream as the liquid stream exits the second end of the tubular chamber.

149. The chromatographic system of claim 148, wherein the void spaces are filled with the secondary particles such that the frit has a density of at least 50%.

150. The chromatographic system of claim 148, wherein the at least one frit is press fit into the first and second ends of the tubular chamber.

151. The chromatographic system of claim 148, further including inlet and outlet fittings operably connected to the first and second ends of the tubular chamber, respectively.

152. The chromatographic system of claim 150, wherein the at least one frit is press fit into the inlet and outlet fittings.

153. The chromatographic system of claim 148, wherein the at least one frit includes a first frit press fit into the inlet fitting or chamber, and a second frit press fit into the outlet fitting or chamber.

154. The chromatographic system of claim 148, wherein the at least one frit includes a first frit arranged in an opening of the inlet fitting, and a second frit arranged in an opening of the outlet fitting.

155. The chromatographic system of claim 153, wherein the first frit is arranged with its top surface oriented toward the tubular chamber, and the second frit is arranged with its top surface oriented toward the tubular chamber.

156. The chromatographic system of claim 155, wherein each of the frits is received in a circular planar ring, and each corresponding ring and frit are configured to seal the inlet fitting and the outlet fitting, respectively, with the tubular chamber.

157. The chromatographic system of claim 148, wherein the at least one frit is press fit into a sealing ring.

158. The chromatographic system of claim 148, wherein the column can withstand pressures of about 5,000 to 50,000 psi.

159. The chromatographic system of claim 148, wherein the inlet and outlet fittings are threaded to the first and second ends of the tubular chamber, respectively.

160. The chromatographic system of claim 148, wherein the frit is sintered after the void spaces are filled with the plurality of secondary particles.

161. The chromatographic system of claim 148, wherein the porous support structure is heated to immobilize the secondary particles that fill the void spaces.

162. The chromatographic system of claim 148, wherein the porous support structure comprises a material selected from the group consisting of metals, metal alloys, metal oxides, ceramics, and polymers.

163. The chromatographic system of claim 148, wherein the porous support structure comprises a material selected from the group consisting of sinterable metals, sinterable metal alloys, sinterable metal oxides, sinterable ceramics, and sinterable polymers.

164. The chromatographic system of claim 148, wherein the porous support structure comprises a material selected from the group consisting of stainless steel, titanium, PEEK, polyethylene, Hastaloy™, polypropylene, Teflon™, glass, silica, titania, and zirconia.

165. The chromatographic system of claim 148, wherein the porous support structure is a filter made of stainless steel.

166. The chromatographic system of claim 148, wherein the porous support structure comprises 316 stainless steel.

167. The chromatographic system of claim 148, wherein the porous support structure has a media grade of about 0.5 to 10.

168. The chromatographic system of claim 148, wherein the porous support structure is 0.5 media grade sintered stainless steel.

169. The chromatographic system of claim 148, wherein the porous support structure is 2.0 media grade sintered stainless steel.

170. The chromatographic system of claim 148, wherein the secondary particles are about 3 to 5 microns in diameter.

171. The chromatographic system of claim 148, wherein the secondary particles are about 3.5 microns in diameter.

172. The chromatographic system of claim 148, wherein the secondary particles are about 4 microns in diameter.

173. The chromatographic system of claim 148, wherein the porous support structure is 0.5 media grade sintered stainless steel, and the secondary particles are about 3.5 microns in diameter.

174. The chromatographic system of claim 148, wherein the porous support structure is 2.0 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

175. The chromatographic system of claim 148, wherein the secondary particles have the same composition as the chromatographic packing materials.

176. The chromatographic system of claim 148, wherein the secondary particles have a different composition than the chromatographic packing materials.

177. The chromatographic system of claim 148, wherein the secondary particles have the same composition as the porous support structure.

178. The chromatographic system of claim 148, wherein the secondary particles have a different composition than the porous support structure.

179. The chromatographic system of claim 148, wherein the secondary particles are spherical stainless steel particles.

180. The chromatographic system of claim 148, wherein the secondary particles fill the void spaces of the porous support structure to a depth of greater than about 10 microns.

181. A method for separating and quantifying solutes in a liquid stream, comprising the steps of:

providing a tubular chamber having first and second ends, the tubular chamber being filled with chromatographic packing materials;inserting at least one frit in the inlet and outlet fittings, the frit having: a porous support structure having a plurality of void spaces, a plurality of secondary particles, wherein the void spaces are filled with the plurality of

secondary particles, and wherein the secondary particles are dimensioned with respect to the void spaces such that the frit retains chromatographic packing materials with particle diameters of less than about 2.5 microns;

propelling the liquid stream through the tubular chamber, the liquid stream contacting the chromatographic packing materials in the tubular chamber;

injecting a sample into the liquid stream; and

detecting individual components in the liquid stream as the liquid stream exits the second end of the tubular chamber.

182. The method of claim 181, wherein the void spaces are filled with the secondary particles such that the frit has a density of at least 50%.

183. The method of claim 181, wherein the at least one frit is press fit into the first and second ends of the tubular chamber.

184. The method of claim 181, further including the step of connecting inlet and outlet fittings to the first and second ends of the tubular chamber, respectively.

185. The method of claim 181, wherein the at least one frit is press fit into the inlet and outlet fittings.

186. The method of claim 185, wherein each of the frits is received in a circular planar ring, and each corresponding ring and frit are configured to seal the inlet fitting and the outlet fitting, respectively, with the tubular chamber.

187. The method of claim 181, wherein the at least one frit includes a first frit press fit into the inlet fitting or chamber, and a second frit press fit into the outlet fitting or chamber.

188. The method of claim 181, wherein the at least one frit includes a first frit arranged in an opening of the inlet fitting, and a second frit arranged in an opening of the outlet fitting.

189. The method of claim 188, wherein the sealing ring can withstand pressures of about 5,000 to 50,000 psi.

190. The method of claim 181, wherein the inlet and outlet fittings are threaded to the first and second ends of the tubular chamber, respectively.

191. The method of claim 181, wherein the frit is sintered after the void spaces are filled with the plurality of secondary particles.

192. The method of claim 181, wherein the porous support structure is heated to impregnate the secondary particles in the void spaces.

193. The method of claim 181, wherein the porous support structure comprises a material selected from the group consisting of metals, metal alloys, metal oxides, ceramics, and polymers.

194. The method of claim 181, wherein the porous support structure comprises a material selected from the group consisting of sinterable metals, sinterable metal alloys, sinterable metal oxides, sinterable ceramics, and sinterable polymers.

195. The method of claim 181, wherein the porous support structure comprises a material selected from the group consisting of stainless steel, titanium, PEEK, polyethylene, Hastaloy™, polypropylene, Teflon™, glass, silica, titania, and zirconia.

196. The method of claim 181, wherein the porous support structure is a filter made of stainless steel.

197. The method of claim 181, wherein the porous support structure comprises 316 stainless steel.

198. The method of claim 181, wherein the porous support structure has a media grade of about 0.5 to 2.0.

199. The method of claim 181, wherein the porous support structure is 0.5 media grade sintered stainless steel.

200. The method of claim 181, wherein the porous support structure is 2.0 media grade sintered stainless steel.

201. The method of claim 181, wherein the secondary particles are about 3 to 5 microns in diameter.

202. The method of claim 181, wherein the secondary particles are about 3.5 microns in diameter.

203. The method of claim 181, wherein the secondary particles are about 4 microns in diameter.

204. The method of claim 181, wherein the porous support structure is 0.5 media grade sintered stainless steel, and the secondary particles are about 3.5 microns in diameter.

205. The method of claim 181, wherein the porous support structure is 2.0 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

206. The method of claim 181, wherein the secondary particles have the same composition as the chromatographic packing materials.

207. The method of claim 181, wherein the secondary particles have a different composition than the chromatographic packing materials.

208. The method of claim 181, wherein the secondary particles have the same composition as the porous support structure.

209. The method of claim 181, wherein the secondary particles have a different composition than the porous support structure.

210. The method of claim 181, wherein the secondary particles are spherical stainless steel particles.

211. The method of claim 181, wherein the secondary particles fill the void spaces of the porous support structure to a depth of about 28 microns to 180 microns.

212. A kit for use with a high pressure liquid chromatography column, the column having a chamber with first and second ends, comprising:

a fitting for threaded attachment to one of the first and second ends of the chamber;

at least one frit received in the fitting, the frit having:

a porous support structure having a plurality of void spaces, and

a plurality of secondary particles, wherein the void spaces are filled with the plurality of secondary particles, and wherein the secondary particles are dimensioned with respect to the

void spaces such that the frit retains chromatographic packing materials with particle diameters of less than about 2.5 microns; and

instructions for use.

213. The kit of claim 212, wherein the void spaces are filled with the secondary particles such that the frit has a density of at least 50%.

214. The kit of claim 212, wherein the at least one frit is press fit into the fitting.

215. The kit of claim 212, wherein the sealing ring can withstand pressures of about 5,000 to 50,000 psi.

216. The kit of claim 212, wherein the frit is sintered after the void spaces are filled with the plurality of secondary particles.

217. The kit of claim 212, wherein the porous support structure is heated to immobilize the secondary particles in the void spaces.

218. The kit of claim 212, wherein the porous support structure comprises a material selected from the group consisting of metals, metal alloys, metal oxides, ceramics, and polymers.

219. The kit of claim 212, wherein the porous support structure comprises a material selected from the group consisting of sinterable metals, sinterable metal alloys, sinterable metal oxides, sinterable ceramics, and sinterable polymers.

220. The kit of claim 212, wherein the porous support structure comprises a material selected from the group consisting of stainless steel, titanium, PEEK, polyethylene, Hastaloy™, polypropylene, Teflon™, glass, silica, titania, and zirconia.

221. The kit of claim 212, wherein the porous support structure is a filter made of stainless steel.

222. The kit of claim 212, wherein the porous support structure comprises 316 stainless steel.

223. The kit of claim 212, wherein the porous support structure has a media grade of about 0.5 to 2.0.

224. The kit of claim 212, wherein the porous support structure is 0.5 media grade sintered stainless steel.

225. The kit of claim 212, wherein the porous support structure is 2.0 media grade sintered stainless steel.

226. The kit of claim 212, wherein the secondary particles are about 3 to 5 microns in diameter.

227. The kit of claim 212, wherein the secondary particles are about 3.5 microns in diameter.

228. The kit of claim 212, wherein the secondary particles are about 4 microns in diameter.

229. The kit of claim 212, wherein the porous support structure is 0.5 media grade sintered stainless steel, and the secondary particles are about 3.5 microns in diameter.

230. The kit of claim 212, wherein the porous support structure is 2.0 media grade sintered stainless steel, and the secondary particles are about 4 microns in diameter.

231. The kit of claim 212, wherein the secondary particles have the same composition as the chromatographic packing materials.

232. The kit of claim 212, wherein the secondary particles have a different composition than the chromatographic packing materials.

233. The kit of claim 212, wherein the secondary particles have the same composition as the porous support structure.

234. The kit of claim 212, wherein the secondary particles have a different composition than the porous support structure.

235. The kit of claim 212, wherein the secondary particles are spherical stainless steel particles.

236. The kit of claim 212, wherein the secondary particles fill the void spaces of the porous support structure to a depth of greater than about 10 microns.